

# Feasibility study of utilising Montmorillonite clay as an adsorbent for removing organic toxicants from water

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## ABSTRACT

The aim of this study is to investigate the feasibility of utilizing Montmorillonite and various of its modified forms as an adsorbent for the removal of organic waste from aqueous media. Montmorillonite is a smectite clay mineral based on bidimensional lamellar alumino-silicate structure leading to a naturally high surface area/volume ratio. Due to this reason, like zeolite, Montmorillonite has been proposed as an adsorbent in water treatment applications. Moreover, Montmorillonite is relatively abundant in certain parts of the world and thus it is inexpensive. Chemical and physical property modifications of Montmorillonite are important in order to improve the adsorption affinity of the clay towards different adsorbate species. Two main types of modified Montmorillonite, named as Al-PILCs (alumina-pillared clay) and surfactant-modified clays respectively, were synthesized in this work. Hexadecyltrimethylammonium bromide (HDTMA), a long chain quaternary ammonium cation, was the surfactant used in the preparation of surfactant-modified clays. The clays produced were characterized using the physical nitrogen adsorption Micromeritics ASAP 2000, X-ray diffraction and ICPAES techniques. Adsorption of 6 different organic toxicants; humic acid, two types of dyes (methylene blue and dichloro(R)fluorescein) and three phenolic compounds (phenol, 3-monochlorophenol and 3,5 dichlorophenol), were explored. Most of the adsorbates studied are classified as polluting elements, which cause problem to the environment. A series of batch adsorption experiments has been carried out. Comparative experiments were also conducted using Montmorillonite, the starting clay, as a reference material. The batch adsorption processes are well described by Langmuir isotherm with a very good correlation coefficient and the adsorption capacity of each adsorbent clay towards the particular organic waste was also calculated. The adsorption results demonstrate an interesting ability of surfactant-modified Montmorillonite in separating organic compounds from water. It is because the surfactant molecules alter the hydrophilic surface property of Montmorillonite into the organophilic surface property of the modified clays. These effects enhance the adsorption capacity of the clay towards the organic compounds. It is seen that the preparative route of the clays influences their adsorption properties as compared with the precursor Montmorillonite. Selection of an appropriate combination of the modified clay and the organic adsorbate can optimize the adsorption process. It is, therefore, shown by these experiments that Montmorillonite and its modified forms may be alternative adsorbents in some specific water treatment processes.